SEMESTER END EXAMINATION, MAY, 2024

Course Name: - B.Tech (ME) **Semester: - 2nd**

Paper Name: - Engineering Mechanics **Paper Code: - TES-203**

Time - 3 Hrs + 20 minutes per hour extra time for V.I. & examinees with writer. **Max Marks-70**

समय– 3 घण्टे + 20 मिनट प्रति घंटे अतिरिक्त–दृष्टिबाधित एवं सह लेखक परीक्षार्थियों के लिए। अधिकतम अंक–70

Instructions:

- The question paper consists of three sections namely A, B, C. All sections are compulsory.
- Section A- Each question carries **3 mark. All questions are compulsory.**
- Section B- Answer any **5 out of 7** given questions in maximum one hundred fifty (150) words. Each question carries **7 marks.**
- Section C- Answer any **2 out of 3** given questions in maximum three hundred (300) words. Each question carries **10 marks.**

निर्देश:

- प्रश्न पत्र में तीन खण्ड अ, ब, व स हैं। सभी खण्ड अनिवार्य हैं।
- खण्ड–अ में प्रत्येक प्रश्न तीन अंक का है। सभी प्रश्न अनिवार्य हैं।
- खण्ड–ब में सात प्रश्नों में से किन्हीं पाँच प्रश्नों के उत्तर अधिकतम 150 शब्दों में दें। प्रत्येक प्रश्न सात अंक का है।
- खण्ड–स में तीन प्रश्नों में से किन्हीं दो प्रश्नों के उत्तर अधिकतम (250-300) शब्दों में दें। प्रत्येक प्रश्न 10 अंक का है।

Section – A (खण्ड–अ)

Objective Questions (वस्तुनिष्ठ प्रश्न)

1. Answer all the following questions.
निम्नलिखित सभी प्रश्न अनिवार्य हैं। **5×3 =15**

i) What is the relationship between each force, if three concurrent forces acting on a body according to Lami's theorem?
   a) Directly proportional to the sine of the angle between the other two forces
   b) Inversely proportional to the cosine of the angle between the other two forces
   c) Directly proportional to the cosine of the angle between the other two forces
   d) Inversely proportional to the sine of the angle between the other two forces

ii) If a body weighing 100 N rests on a plane inclined at 75° to the horizontal , the component parallel to the plane is
   a) 25.88 N
   b) 57.7 N
   c) 60 N
   d) 50 N

iii) The moment of inertia of a triangle of base width b and height h about is base is
   a) $bh^3/36$
   b) $bh^3/12$
   c) $bh^3/6$
   d) $bh^3/3$

iv) A simply supported beam of length 4 meters carries a uniformly distributed load of 10 KN/m. What are the reactions at the supports?
   a) 10 KN and 30 KN
   b) 20 KN and 20 KN
   c) 25 KN and 15 KN
   d) 15 KN and 25 KN

v) A block weighing 100 N is placed on a horizontal surface. The coefficient of static friction between the block and the surface is 0.5. What is the maximum horizontal force that can be applied to the block before it starts to move?

a) 50 N
b) 100 N
c) 150 N
d) 200 N

Section – B (खण्ड–ब)
Short Answer Questions (लघूत्तरीय प्रश्न)

2. Answer any five of the following questions in maximum 150 words. 5×7=35
निम्नलिखित में से किन्हीं पाँच प्रश्नों के उत्तर अधिकतम 150 शब्दों में दें।

i. Determine the resultant of the system of forces acting on a beam as shown in Fig.1.

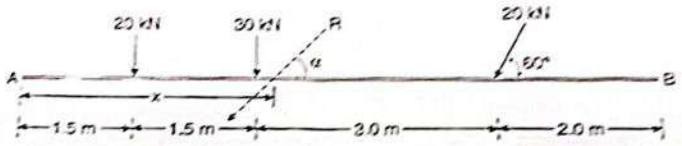

Fig.1

ii. Find the forces in all the members of the truss shown in Fig.2.

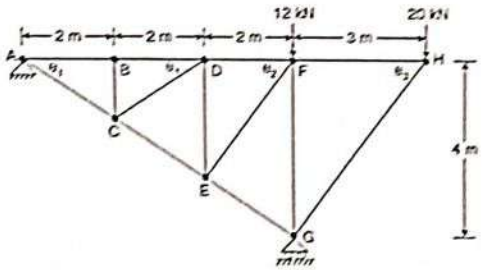

Fig.2

iii. Block A weighing 1000 N rests over block B which weighs 2000 N as shown in Fig.3. Block A is tied to wall with a horizontal string. If the coefficient of friction between blocks A and B is 0.25 and between B and floor is 1/3, what should be the value of P to move the block (B), if

(a) P is horizontal. (b) P acts at 30° upwards to horizontal

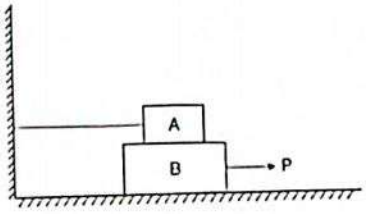

Fig.3

iv. The simply supported beam AB of span 5m is subjected to a concentrated load and external moment as shown in Fig.4. Determine the reaction at B.

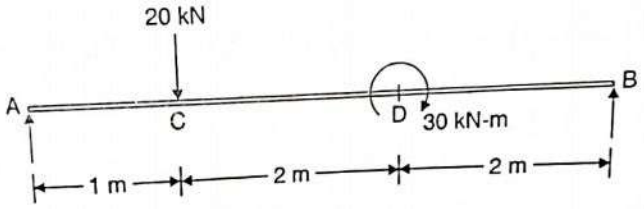

Fig.4

v. A roller of weight 500 N rests on a smooth inclined plane and is kept free from rolling down by a string as shown in Fig.5. Work out tension in the string and reaction at the point of contact B.

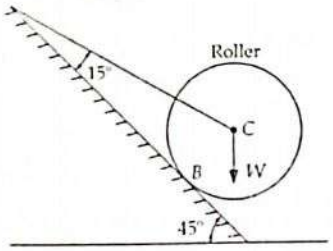

Fig.5

vi. State and prove triangle law and polygon law of forces.

vii. State and prove Lami's theorem. Describe angle of friction, angle of repose and cone of friction with neat sketch.

Section – C (खण्ड–स)

Descriptive Questions (विवरणात्मक प्रश्न)

3. Answer any two of the following question in maximum 300 words. **2×10=20**
निम्नलिखित में से किन्हीं दो प्रश्नों के उत्तर अधिकतम 300 शब्दों में दें।

i) (a) A ladder weighing 100 N is to be kept in the position shown in Fig.6 resting on a smooth floor and leaning on a smooth wall. Determine the horizontal force required at floor level to prevent it from slipping when a man weighing 700 N is at 2 m above floor level.

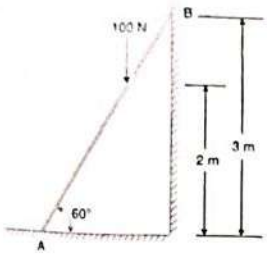

Fig.6

(b) Determine the reactions at A, B and D of the compound beam shown in Fig.7. Neglect the self-weight of the members.

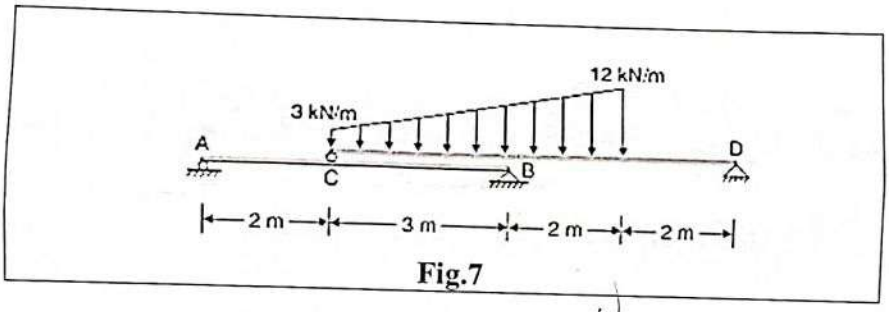

Fig.7

ii) **(a)** Explain the behaviour of stress-strain curve for the mild steel specimen by describing various points and its practical importance.

(b) Find the second moment of the shaded portion shown in Fig.8 about its centroidal axis.

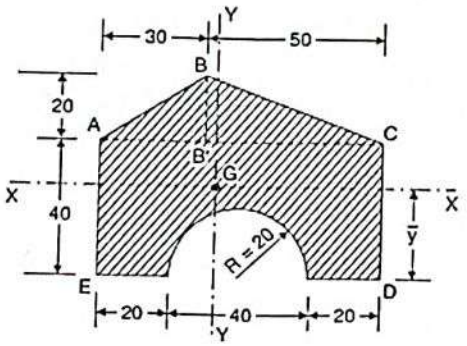

Fig.8

iii) **(a)** A circular rod of diameter 16 mm and 500 mm long is subjected to a tensile force 40 KN. The modulus of elasticity for steel may be taken as 200 KN/mm^2. Find stress, strain and elongation of the bar due to applied load.

(b) The bar shown in Fig.9 is tested in universal testing machine. It is observed that at a load of 40 KN and the total extension of the bar is 0.280 mm. Determine the Young's modulus of the material.

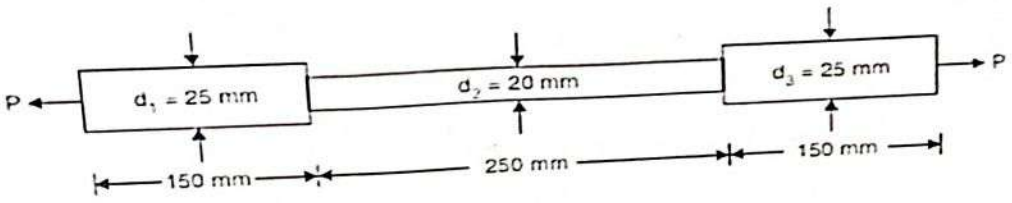

Fig.9

v) In a simply supported beam of 5m span a 30 KN-m moment is acting at a distance 2 m from support A. In this beam reaction at support A is

a) 15 KN
b) 6 KN
c) 12 KN
d) 75 KN

Section - B (खण्ड–ब)

Short Answer Questions (लघुउत्तरीय प्रश्न)

5×7=35

2. Answer any five of the following questions in maximum 150 words.
निम्नलिखित में से किन्हीं पाँच प्रश्नों के उत्तर अधिकतम 150 शब्दों में दें।

i. Find the reactions developed at supports A and B of the loaded beam shown in Fig.1.

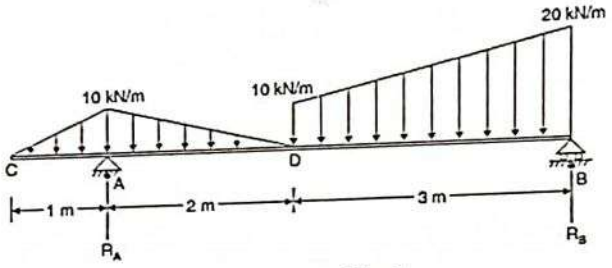

Fig.1

ii. Find the forces in all the members of the truss shown in Fig.2.

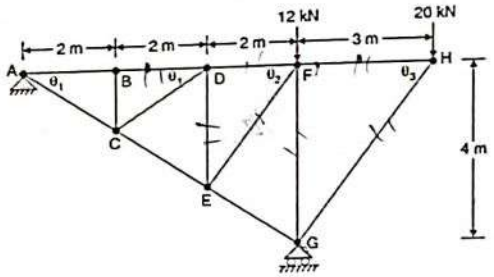

Fig.2

iii. Determine the resultant magnitude and angle of the three forces acting on a hook as shown in Fig.3

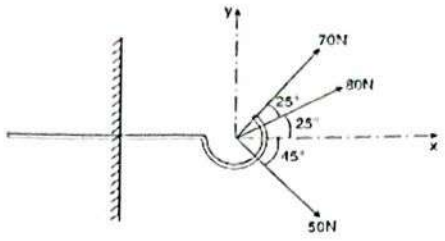

Fig.3

iv. Differentiate between center of gravity and centroid. Under what condition these will coincide? State triangle law and polygon law of forces.

v. Block A weighing 1000 N rests over block B which weighs 2000 N as shown in Fig.4. Block A is tied to wall with a horizontal string. If the coefficient of friction between blocks A and B is 0.25 and between B and floor is 1/3, what should be the value of P to move the block (B), if

(a) P is horizontal. (b) P acts at 30° upwards to horizontal

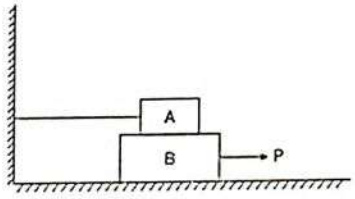

Fig.4

vi. A ladder weighing 100 N is to be kept in the position shown in Fig.5, resting on a smooth floor and leaning on a smooth wall. Determine the horizontal force required at floor level to prevent it from slipping when a man weighing 700 N is at 2m above floor level.

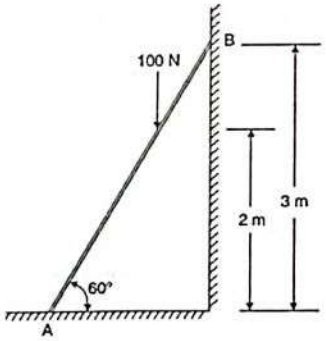

Fig.5

Section – C (खण्ड–स)

Descriptive Questions (विवरणात्मक प्रश्न)

2×10=20

3. **Answer any two of the following question in maximum 300 words.**
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i) **(a)** Explain the behaviour of stress-strain curve for the mild steel specimen by describing various points and its practical importance with neat sketch.

(b) Determine the forces in the members FH, HG and GI in the truss shown in Fig.6. Each load is 10 kN and all triangles are equilaterals with sides equal to 4 m.

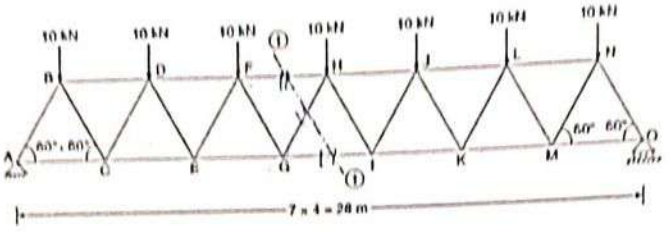

Fig.6

ii) **(a)** Find the second moment of the shaded portion shown in Fig.7 about its centroidal axis.

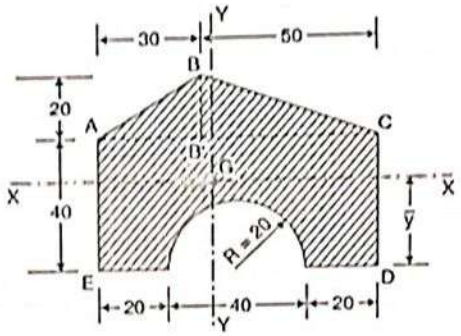

Fig.7

(b) Explain the type of loads supports and beams with neat sketch. State and prove Lami's theorem.

iii) **(a)** A circular rod of diameter 16 mm and 500 mm long is subjected to a tensile force 40 KN. The modulus of elasticity for steel may be taken as 200 KN/mm^2. Find stress, strain and elongation of the bar due to applied load.

(b) The bar shown in Fig.8 is tested in universal testing machine. It is observed that at a load of 40 KN and the total extension of the bar is 0.280 mm. Determine the Young's modulus of the material.

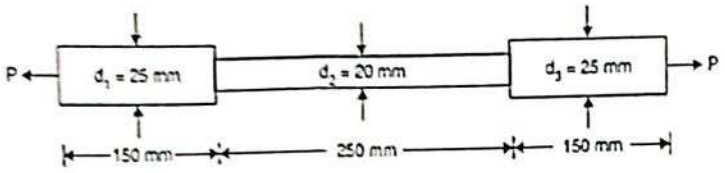

Fig.8

(c) Describe the angle of friction, angle of repose and cone of friction with neat sketch.